CLAIMS

1. A dispersoid having metal-oxygen bonds which is obtained by mixing a metal compound having at least three hydrolyzable groups with a given amount of water in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer and at a given temperature, which dispersoid is characterized in that the given amount of water is at least 1.0 mole but less than 2.0 moles per mole of the metal compound, and the given temperature is a temperature below 0°C.

2. A dispersoid having metal-oxygen bonds which is obtained by mixing a metal compound having at least three hydrolyzable groups with a given amount of water in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer and at a given temperature, which dispersoid is characterized in that the given amount of water is at least 0.5 mole but less than 1.0 mole per mole of the metal compound, and the given temperature is a temperature below 0°C.

3. The dispersoid having metal-oxygen bonds of claim 1 or 2 which is characterized in that the given temperature is a temperature of -20°C or below.

4. The dispersoid having metal-oxygen bonds of claim 1 or 2 which is characterized in that the given temperature is at or below the temperature at which the metal compound begins to hydrolyze.

5. The dispersoid having metal-oxygen bonds of claim 1 or 2 which is characterized in that the given temperature is a temperature in a range of -50 to -100°C.

6. The dispersoid having metal-oxygen bonds of any one of claims 1 to 5 which is characterized by using an organic solvent in the step in which the metal compound and the given amount of water are mixed.

7. The dispersoid having metal-oxygen bonds of any one of claims 1 to 6 which is characterized in that the step in which the metal compound and the given amount of water are mixed is a step in which the given amount of water is added to the metal compound.

8. The dispersoid having metal-oxygen bonds of claim 7 which is characterized in that the step in which the given amount of water is added to the metal compound is a step in which the given amount of water is added to an organic solvent solution of the metal compound.

9. The dispersoid having metal-oxygen bonds of any one of claims 6 to 8 which is characterized in that the organic solvent is a hydrocarbon solvent or an ether solvent.

10. The dispersoid having metal-oxygen bonds of any one of claims 1 to 9 which is characterized in that the given amount of water is a solution diluted with a water-soluble organic solvent.

11. The dispersoid having metal-oxygen bonds of claim 10 which is characterized in that the water-soluble organic solvent is an alcohol solvent.

12. The dispersoid having metal-oxygen bonds of any one of claims 1 to 11 which is characterized by being obtained by, following mixture of the metal compound and the water at the given temperature, raising the temperature to the given temperature or above.

13. A dispersoid having metal-oxygen bonds obtained by mixing, in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer and at a given temperature, a partial hydrolysate that is prepared by hydrolyzing a metal compound having at least three hydrolyzable groups in the absence of an acid, a base and/or an dispersion stabilizer and that can be stably dispersed without aggregation in an organic solvent with an amount of water equal to at least 0.5 mole but less than 2 moles

per mole of the metal compound minus the amount of water used to prepare the partial hydrolysate, which dispersoid is characterized in that the given temperature is a temperature below 0°C.

14. The dispersoid having metal-oxygen bonds of claim 13 which is characterized in that the given temperature is a temperature of -20°C or below.

15. The dispersoid having metal-oxygen bonds of claim 13 or 14 which is characterized in that the given temperature is at or below the temperature at which the metal compound begins to hydrolyze.

16. The dispersoid having metal-oxygen bonds of claim 13 or 14 which is characterized in that the given temperature is a temperature in a range of -50 to -100°C.

17. The dispersoid having metal-oxygen bonds of any one of claims 13 to 16 which is characterized by using an organic solvent in the step in which the partial hydrolysate and the given amount of water are mixed.

18. The dispersoid having metal-oxygen bonds of any one of claims 13 to 17 which is characterized in that the step in which the partial hydrolysate and the given amount of water are mixed is a step in which the given amount of water is added to the partial hydrolysate.

19. The dispersoid having metal-oxygen bonds of claim 18 which is characterized in that the step in which the given amount of water is added to the partial hydrolysate is a step in which the given amount of water is added to an organic solvent solution of the partial hydrolysate.

20. The dispersoid having metal-oxygen bonds of any one of claims 17 to 19 which is characterized in that the organic solvent is a hydrocarbon solvent or an ether solvent.

21. The dispersoid having metal-oxygen bonds of any one of claims 13 to 20 which is characterized in that the given amount of water is a solution diluted with a water-soluble organic solvent.

22. The dispersoid having metal-oxygen bonds of claim 21 which is characterized in that the water-soluble organic solvent is an alcohol solvent.

23. The dispersoid having metal-oxygen bonds of any one of claims 13 to 22 which is characterized by being obtained by, following mixture of the partial hydrolysate and the water at the given temperature, raising the temperature to the given temperature or above.

24. A dispersoid having metal-oxygen bonds which is obtained by mixing a metal compound having at least three hydrolyzable groups with a given amount of water in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer and at a given temperature, which dispersoid is characterized in that the given amount of water is a solution diluted with a hydrocarbon solvent and an alcohol solvent, the diluted solution is added to the metal compound, and the given temperature is room temperature.

25. The dispersoid having metal-oxygen bonds of claim 24 which is characterized in that the given amount of water is at least 0.5 mole but less than 2.0 moles per mole of the metal compound.

26. The dispersoid having metal-oxygen bonds of claim 24 or 25 which is characterized in that the water in the diluted solution has a concentration that is from 40% to 1% of the saturation solubility of water in a mixed solvent of the hydrocarbon solvent and the alcohol solvent.

27. A dispersoid having metal-oxygen bonds which is obtained by the addition, to a metal compound having at least three hydrolyzable groups, of at least 0.5 mole but less than 2 moles of water per mole of the metal compound, which dispersoid is characterized by having steps in which the water is added in a some of divided portions at a given temperature, which steps include at least one step in which the given temperature is a temperature below 0°C.

28. A dispersoid having metal-oxygen bonds which is obtained by the addition, to a metal compound having at least three hydrolyzable groups, of at least 0.5 mole but less than 2 moles of water per mole of the metal compound, which dispersoid is characterized by having steps in which the water is added in a some of divided portions, at least 0.5 mole but less than 1 mole of the water per mole of the metal compound being added in a first water addition step.

29. The dispersoid having metal-oxygen bonds of claim 28 which is characterized by having, after the first water addition step, a step in which the rest of the required amount of water is added at a given temperature, the given temperature being a temperature below 0°C.

30. The dispersoid having metal-oxygen bonds of claim 27 or 29 which is characterized in that the given temperature is a temperature of -20°C or below.

31. The dispersoid having metal-oxygen bonds of claim 27 or 29 which is characterized in that the given temperature is at or below the temperature at which the metal compound begins to hydrolyze.

32. The dispersoid having metal-oxygen bonds of claim 27 or 29 which is characterized in that the given temperature is in a range of -50 to -100°C.

33. The dispersoid having metal-oxygen bonds of any one of claims 27 to 32 which is characterized in that, following the step in which the water is added at the given temperature, the temperature is raised to the given temperature or above.

34. A dispersoid having metal-oxygen bonds which is characterized by being obtained by concentrating a solution of the dispersoid having metal-oxygen bonds of any one of claims 1 to 33.

35. The dispersoid having metal-oxygen bonds of any one of claims 1 to 34 which is characterized in that the metal compound is a compound of formula (I)

$$R_aMX_b \qquad (I)$$

(wherein M is a metal atom, X is a hydrolyzable group, R is a hydrogen atom or an organic group which may have a hydrolyzable group capable of forming a bond with the metal atom through an oxygen atom, and a+b = m, where m is the valence of the metal atom).

36. The dispersoid having metal-oxygen bonds of claim 35 which is characterized in that X in formula (I) is an alkoxy group.

37. The dispersoid having metal-oxygen bonds of any one of claims 1 to 36 which is characterized in that the metal is one or more selected from the group consisting of titanium, zirconium, aluminum, silicon, germanium, indium, tin, tantalum, zinc, tungsten and lead.

38. The dispersoid having metal-oxygen bonds of any one of claims 1 to 37 which is characterized by being a dispersoid which stably disperses without aggregation in an organic solvent in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer.

39. The dispersoid having metal-oxygen bonds of any one of claims 1 to 38 which is characterized in that a solution containing the dispersoid is optically transparent.

40. The dispersoid having metal-oxygen bonds of any one of claims 1 to 39 which is characterized by having an average particle size, when dispersed in an organic solvent, in a range of 1 to 20 nm.

41. The dispersoid having metal-oxygen bonds of claim 40 which is characterized by being monodisperse with a particle size distribution in a range of 0 to 50 nm.

42. The dispersoid having metal-oxygen bonds of claim 40 or 41 which is characterized in that the organic solvent is an ether solvent or a hydrocarbon solvent.

43. A dispersoid having metal-oxygen bonds which is characterized by dispersing stably without aggregation in an organic solvent in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer, and by having an average particle size in a range of 1 to 20 nm.

44. The dispersoid having metal-oxygen bonds of claim 43 which is characterized by being monodisperse with a particle size distribution in a range of 0 to 50 nm.

45. The dispersoid having metal-oxygen bonds of claim 43 or 44 which is characterized in that the organic solvent is an ether solvent or a hydrocarbon solvent.

46. A metal oxide film which is characterized by being produced from the dispersoid of any one of claims 1 to 45.

47. A metal oxide film which is characterized by being produced by coating or spraying a solution containing the dispersoid of any one of claims 1 to 45, then heating at a temperature of 200°C or below.

48. A metal oxide film which is characterized by being produced by coating or spraying a solution containing a dispersoid according to any one of claims 1 to 45 and fine metal oxide crystals derived from the dispersoid, then heating at a temperature of 200°C or below.

49. The metal oxide film of claim 47 or 48 which is characterized by being produced by, additionally, exposure to ultraviolet light having a wavelength of 360 nm or less.

50. The metal oxide film of any one of claims 46 to 49 which is characterized by having a smooth film surface.

51. The metal oxide film of any one of claims 46 to 49 which is characterized in that the film surface has an average roughness of 10 nm or less.

52. The metal oxide film of any one of claims 46 to 49 which is characterized in that the film surface has an average roughness of 5 nm or less.

53. The metal oxide film of any one of claims 46 to 49 which is characterized by being formed on a plastic substrate and having a carbon content, expressed as an atomic ratio, of 10% or less.

54. A metal oxide film which is characterized by being formed by coating or spraying, and by having a smooth film surface.

55. The metal oxide film of claim 54 which is characterized by being formed by drying at 200°C or below.

56. The metal oxide film of claim 54 or 55 which is characterized in that the film surface has an average roughness of 10 nm or less.

57. The metal oxide film of claim 54 or 55 which is characterized in that the film surface has an average roughness of 5 nm or less.

58. A metal oxide film which is characterized by being formed on a plastic substrate and by having a carbon content, expressed as an atomic ratio, of 10% or less.

59. An organic-inorganic hybrid material characterized by containing at least one selected from the group consisting of a dispersoid having metal-oxygen bonds according to any one of claims 1 to 30, an inorganic structural portion derived from the dispersoid, and an inorganic polymer obtained from the dispersoid as the starting material.

60. The organic-inorganic hybrid material of claim 59 which is characterized in that the organic component is at least one selected from the group consisting of acrylic resins, polythiourethane resins and resins obtained from epithio group-bearing compounds.

61. The organic-inorganic hybrid material of claim 59 or 60 which is characterized by being produced by polymerizing an organic monomer in the presence of a dispersoid having metal-oxygen bonds according to any one of claims 1 to 45.

62. An optical material which is characterized by containing an organic-inorganic hybrid material of any one of claims 59 to 61.

63. An optical product which is characterized by being made of the optical material of claim 62.

64. The optical product of claim 63 which is characterized by being a plastic lens.

65. A monomolecular film which is characterized by being obtained by forming a metal oxide film having a smooth surface on a substrate, then contacting the metal oxide film with a metallic surfactant having at least one hydrolyzable group.

66. The monomolecular film of claim 65 which is characterized in that the metal oxide film having a smooth surface is a metal oxide film according to any one of claims 46 to 59.

67. A monomolecular film characterized by being obtained by using a dispersoid having metal-oxygen bonds that is stably dispersed without aggregation in an organic solvent in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer, or using a solution containing the dispersoid, to form a metal oxide film on a substrate, then contacting the metal oxide film with a metallic surfactant having at least one hydrolyzable group.

68. The monomolecular film of claim 67 which is characterized in that the dispersoid having metal-oxygen bonds that is stably dispersed without aggregation in an organic solvent in the absence of at least one selected from the group consisting of an acid, a base and a dispersion stabilizer is a dispersoid according to any one of claims 1 to 45.

69. The monomolecular film of any one of claims 65 to 68 which is characterized in that the metallic surfactant is a compound of formula (II)

$$R^1_nMY_{m-n} \qquad \text{(II)}$$

(wherein R^1 is a monovalent hydrocarbon group, a monovalent hydrocarbon group having a substituent, a monovalent halogenated hydrocarbon group, a monovalent hydrocarbon group which includes a linkage or a monovalent halogenated hydrocarbon group which includes a linkage, M is at least one type of metal atom selected from the group consisting of silicon, germanium, tin, titanium and zirconium atoms, Y is a hydrolyzable group, the letter n is any integer from 1 to (m-1), and the letter m is the valence of M; with the

proviso that if n is 2 or more, each R^1 may be like or unlike, and if (m-n) is 2 or more, each Y may be like or unlike).

70. The monomolecular film of claim 69 which is characterized in that the compound of formula (II) is a compound of formula (III)

$$CF_3—(CF_3)_p—R^2{}_q—MZ_rY_{m-r-1} \qquad \text{(III)}$$

(wherein R^2 is an alkylene group, a vinylene group, an ethynylene group, an arylene group or a divalent functional group containing a silicon atom and/or an oxygen atom, Z is a hydrogen atom, an alkyl group, an alkoxy group, a fluoroalkyl group or a fluoroalkoxy group, Y, M and m are as defined above, the letter p is 0 or an integer, the letter q is 0 or 1, and the letter r is 0 or any integer from 1 to (m-2)).